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10/796,587	03/09/2004	Ahmad A. Naiini	339.7807USU	1113

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Stamford, CT 06901-2682

EXAMINER

CHU, JOHN S Y

ART UNIT	PAPER NUMBER
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1752

DATE MAILED: 04/07/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/796,587

Applicant(s)

NAIINI ET AL.

Examiner

John S. Chu

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 09 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-59 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1-11 is/are allowed.
- 6) ☒ Claim(s) 12-20, 22, 23, 25, 26, 29-33, 36-40, 43, 44, 49-51, 54 and 55 is/are rejected.
- 7) ☒ Claim(s) 21, 24, 27, 28, 34, 35, 41, 42, 45-48, 52, 53 and 56-59 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>7/16/04</u> . | 6) <input type="checkbox"/> Other: _____  |

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### DETAILED ACTION

This Office action is in response to the application filed March 9, 2004.

#### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 12-20, 22, 23, 25, 26, 29-31, 38-40, 43, 44, 49-51 are rejected under 35

U.S.C. 102(b) as being clearly anticipated by TAKAHASHI et al (6,376,151 B1) or

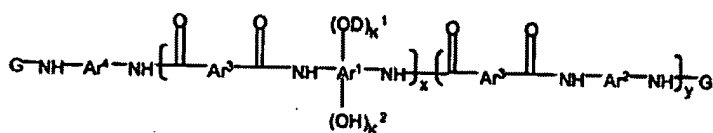
HAMMERSCHMIDT et al (5,376,499).

The claimed invention is drawn to the following in claim 12:

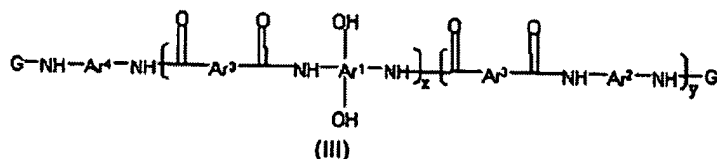
**12. A positive photosensitive resin composition comprising:**

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(a) at least one polybenzoxazole precursor polymer selected from the group consisting of polymers having Structure I and III;

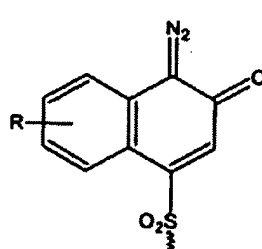
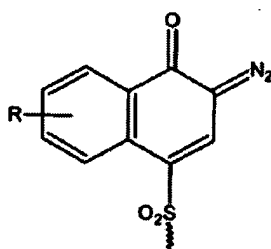
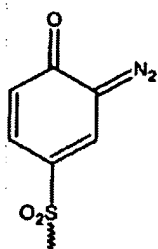


(I)

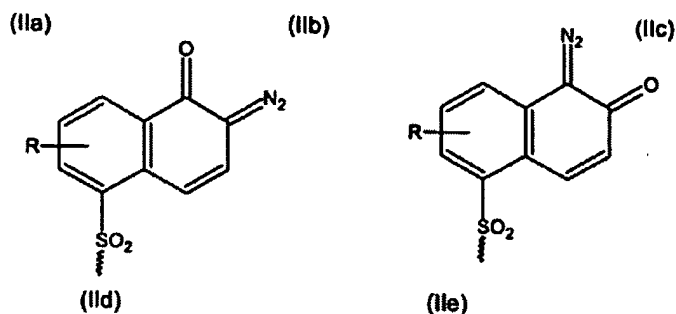


(III)

wherein  $\text{Ar}^1$  is selected from the group consisting of a tetravalent aromatic group, a tetravalent heterocyclic group and mixtures thereof;  $\text{Ar}^2$  is selected from the group consisting of a divalent aromatic, a divalent heterocyclic, a divalent alicyclic and a divalent aliphatic group that may contain silicon and mixtures thereof;  $\text{Ar}^3$  is selected from the group consisting of a divalent aromatic group, a divalent aliphatic group, a divalent heterocyclic group and mixtures thereof;  $\text{Ar}^4$  is selected from the group consisting of  $\text{Ar}^1(\text{OH})_2$  and  $\text{Ar}^2$ ; D is selected from the group consisting of one of the following moieties IIa-IIe:

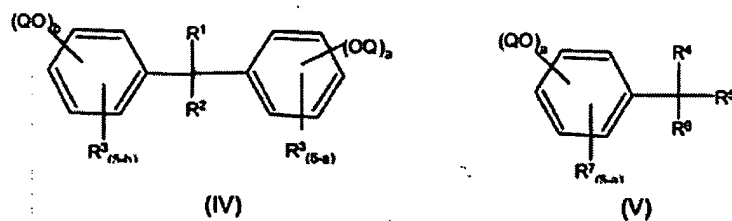


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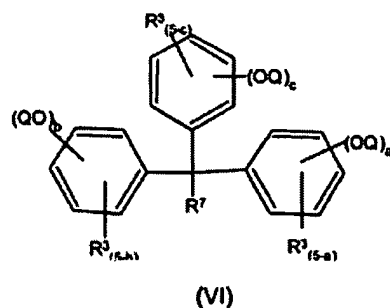


wherein, R is selected from the group consisting of H, a C<sub>1</sub> - C<sub>4</sub> alkyl group, a C<sub>1</sub> - C<sub>4</sub> alkoxy group and a cyclohexyl group; k<sup>1</sup> can be any positive value of up to about 0.5, k<sup>2</sup> can be any value from about 1.5 to 2 with the proviso that (k<sup>1</sup>+k<sup>2</sup>)=2, x is from about 10 to about 1000; y is from about 0 to about 900; and G is an organic group having a carbonyl, carbonyloxy or sulfonyl group attached directly to the terminal NH of the polymer,

(b) at least one non-polymeric photosensitive compound comprising a compound having within its structure one or more of moieties selected from the group consisting of IIa-IIe, with the proviso that if a polymer of Structure III is the sole polybenzoxazole precursor polymer, the non-polymeric photosensitive compound is selected from the group consisting of compounds described by structures IV - VI,



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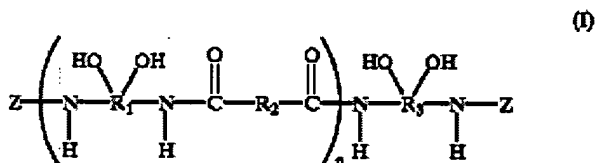
wherein  $R^1$ ,  $R^2$ ,  $R^4$ ,  $R^5$ ,  $R^6$  and  $R^7$  each independently are selected from the group consisting of a linear or branched  $C_1 - C_4$  alkyl group, a phenyl or halide substituted  $C_1 - C_4$  linear or branched alkyl group, a perfluorinated  $C_1 - C_4$  linear or branched alkyl group, a  $C_5 - C_7$  cycloalkyl group, a  $C_1 - C_4$  alkyl or halide substituted  $C_5 - C_7$  cycloalkyl group, or alternatively  $R^1$  and  $R^2$  or any two of  $R^4$ ,  $R^5$ , and  $R^6$  may together form a 5-7 membered ring; each  $R^3$  is independently selected from the group consisting of H, a linear or branched  $C_1 - C_4$  alkyl group, a phenyl or halide substituted  $C_1 - C_4$  linear or branched alkyl group, a perfluorinated linear or branched  $C_1 - C_4$  alkyl group, a  $C_5 - C_7$  cycloalkyl group, a  $C_1 - C_4$  alkyl or halide substituted  $C_5 - C_7$  cycloalkyl group, an unsubstituted phenyl group, and a phenyl or alkyl or halide substituted phenyl group; Q is selected from the group consisting of H or D with the proviso that at least one Q = D; D is selected from the group consisting of one of the moieties IIa-IIe; a is an integer from 1 to 5; b and c are integers from 0 to 5 with the provisos: (1) that for Structure IV, if  $a = b = 1$  and both OQ are substituted para to the  $R^1R^2C$  substituent, then both  $R^1$  and  $R^2$  are not simultaneously methyl, and (2)  $1 \leq a+b < 6$ ; and the proviso that for Structure VI, if  $a = b = c = 1$  and all OQ are para to the triphenyl methane carbon substituent, then at least one  $R^3$  is not H; and

(c) at least one solvent.

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TAKAHASHI et al discloses a positive resist composition comprising a hydroxypolyamide represented by the following formula:

**A positive resist composition comprising a hydroxypolyamide represented by the following general formula (I) and a photoactive component:**



wherein the hydroxypolyamide is end-capped by a group Z defined as a monovalent group and as a photoactive compound a diazoquinone compound, see column 3, line 5 - column 4, line 4 for the composition, column 6, line 20 - column 7, line 43 for the diazoquinone compound or a 1,2-naphthoquinonediazide compound and column 13, line 28 - column 14, line 68 wherein photoresist compositions are tested for viscosity stability after being stored for a week at room temperature. The endcapped groups on the hydroxypolyamide are disclosed in column 5, lines 9-65, see the image below wherein the terminating group are subjected to any of the three group disclosed: (1) sulfonating agent, (2) phthalic acid anhydride, and (3) saturated cyclic acid anhydride.

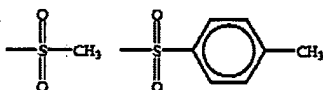
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(1) The terminal amino groups are subjected to condensation with a sulfonating agent (e.g. methanesulfonyl chloride, p-toluenesulfonyl chloride or 2-nitrobenzenesulfonyl chloride) to block the amino groups in the form of sulfonamide group.

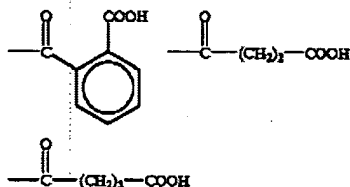
(2) The terminal amino groups are subjected to condensation with phthalic acid anhydride and/or its derivative (e.g. 4-methylphthalic acid anhydride or 4-chlorophthalic acid anhydride) to block the amino groups in the form of phthalic acid-combined amino group.

(3) The terminal amino groups are subjected to condensation with a saturated aliphatic hydrocarbon-based cyclic acid anhydride (e.g. succinic acid anhydride, 2-formamidosuccinic acid anhydride, methylsuccinic acid anhydride, 2,2-dimethylsuccinic acid anhydride, acetoxysuccinic acid anhydride, acetylmercaptosuccinic acid anhydride, glutaric acid anhydride, 3-methylglutaric acid anhydride, 2,2-dimethylglutaric acid anhydride or 3,3-dimethylglutaric acid anhydride) to block the amino groups in a state that an aliphatic acid is bonded to the polymer terminals in the form of free amidocarboxylic acid group.

Examples of the amide blocking group Z used herein are preferably the followings groups when the X of the structural formula (II) or (IV) is a sulfonyl group:



and the followings groups when the X is a carbonyl group:



The ratio of terminal blocking in the form of amide must be 40 mole % or more of the total terminal amine groups, with 60 mole % or more being preferred.

A ratio of terminal blocking in the form of amide, smaller than 40 mole % is not preferred because, when the hydroxypolyamide is formulated into a positive resist, the resist is unable to fully exhibit excellent storage stability, lithography property and cured film property which are the meritorious effects of the present invention.

Examples 1-3, columns 8, line 33 – column 9, line 41 disclose the specific end-capped groups on the hydroxypolyamide, each being Ex. 1 end-capped with methanesulfonyl chloride; Ex. 2 the same as Ex. 1 having different dicarboxylic group in the polyamide; and Ex. 3 having an end-capped group of p-toluenesulfonyl chloride.

The method claims as recited in 38-40, 43 and 44 are met by the disclosure found in column 18, lines 19-39, wherein the photoresist is coated on a wafer dried at 80° C, exposed to

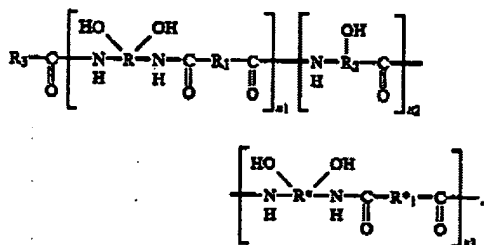


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light through a high pressure mercury lamp, developed and heat treated a 200° C for 30 minutes and then at 400° C for 1 hour.

The substrate is disclosed in the resultant Example 10, column 17, line 39 – column 19, line 15.

HAMMERSCHMIDT et al discloses an end-capped hydroxypolyamide precursor, see the image below and column 2, lines 20 – 35:



the photosensitive compound is a diazoquinone compound as disclosed in column 5, lines 57-68.

### *Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 12-20, 22, 23, 25, 26, 29-33, 38-40, 43, 44, 49-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over TAKAHASHI et al (6,376,151 B1) or HAMMERSCHMIDT et al (5,376,499) in view of HIRANO et al (6,071,666).

The claimed invention has been recited above and is included by reference.

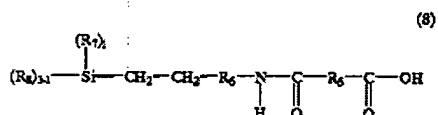
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TAKAHASHI et al and HAMMERSCHMIDT et al have been recited above in paragraph 2 with respect to disclosing an end-capped hydroxypolybenzoxazole precursor in a formulation with a diazoquinone compound.

TAKAHASHI et al disclose the use of additives such as phenolic compounds, leveling agents and silane coupling agents, see column 7, lines 44-49, while HAMMERSCHMIDT et al likewise teaches the use of adhesive agents, wetting agents, or mixtures thereof for their advantageous use in manufacturing relief structures.

Each of the references in the current rejection lacks a specific disclosure for the specific silane adhesion promoting agent as disclosed in claims 32-33.

HIRANO et al has been cited to disclose a positive photosensitive resin composition comprising a polyamide of formula (I), a photosensitive diazoquinone compound, a phenol compound and an organosilane compound (see column 4, lines 33 – et seq.) as exemplified here:



The skilled artisan is clearly motivated to use additive ingredients in order to modify and adjust the compositional properties as desired wherein the said organosilane compound specifically designed for increasing adhesion, see column 21, lines 21-33.

It would have been prima facie obvious to one of ordinary skill in the art of positive photosensitive resin composition comprising a polybenzoxazole precursor for semiconductor devices to add an organosilane agent as taught in HIRANO et al as an adhesion promoter and reasonably expect same or similar results as disclosed in TAKAHASHI et al and

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HAMMERSCHMIDT et al for having a composition with excellent mechanical properties and a high durable pattern resistance to deformation due to heat.

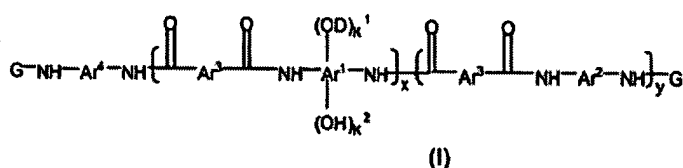
5. Claims 21, 24, 27, 28, 34, 35, 41, 42, 45-48, 52, 53, 56-59 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

None of the references of record disclose limitations as recited in those claims drawn to a composition having the end-capped photosensitive hydroxypolybenzoxazole precursor with a second non-polymeric photosensitive diazoquinone compound and its use in a pattern forming process on a substrate and the substrate.

6. Claims 1-11 are allowed.

None of the prior art references of record disclose the claimed polybenzoxazole having an end-capped group defined as "G" and having diazoquinone chemically bound at the hydroxyl groups on the polymer, see below:

A polybenzoxazole precursor polymer with Structure I

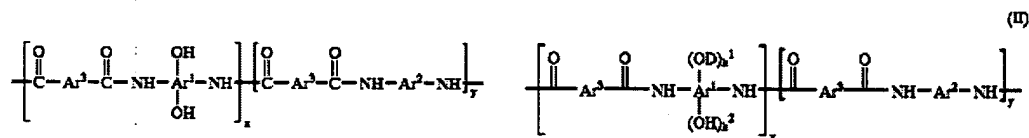


7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. BANBA et al (5,449,584) and KHANNA (5,037,720) disclose a hydroxypolyamide resin chemically bound by to diazoquinone compound. These references lack an end-capped group as claimed on a photosensitive hydroxypolyamide. BANBA et al discloses both a chemically bound hydroxypolyamide and a composition which comprises the a mixture of a hydroxypolyamide in a mixture with a diazoquinone compound.

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WATERSON et al (6,127,086) and WEBER et al (6,177,225 B1) disclose photosensitive resin composition wherein the polybenzoxazole is chemically bound to a diazoquinone compound. The inventors characterize the resins as capped, however these resins are not end-capped as currently claimed having a group "G" on the end portions.

NAIINI et al (2004/0229167 A1) is to application 10/793,337, which is copending, commonly assigned and has one common inventor. This patent publication discloses a positive photoresist composition comprising a resin blend of a polybenzoxazole and a photosensitive polybenzoxazole, neither of these resins are end-capped as claimed in the current application, see the image of the two resin structures:



Further the copending application recites at least one photosensitive compound and a solvent in addition to the resin blend already having a chemically bound photosensitive diazoquinone. Thus there is no obviousness-type double patenting rejection with the current application which recites an end-capped polybenzoxazole as seen above.

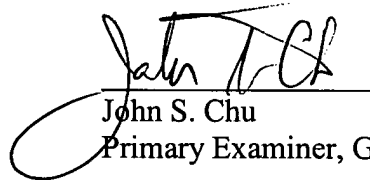
5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Chu whose telephone number is (571) 272-1329. The examiner can normally be reached on Monday - Friday from 9:30 am to 6:00 pm.

The fax phone number for the USPTO is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (571) 272-1700.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PMR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



John S. Chu  
Primary Examiner, Group 1700

J.Chu  
March 13, 2005